AMENDMENT TO THE DRAWINGS

Please replace the original FIGS. 5D and 5E with the respective replacement sheets attached at the end of this response after page 20. All replacement sheets are denoted with "Prior Art" as suggested by the Examiner in this Office Action (OA). No new matter has been added.

REMARKS

In the above reference case, Claims 1-15 are pending. Applicant will sequentially address the issues raised by the Examiner in the Office Action.

I. Claim Status

Claims 1-15 were submitted for examination. Claims 1, 6, 7 and 11 have been amended. No new matters have been added. As a result, claims 1-15 are now pending.

II. Drawings Objection

As indicated in the amendment to the drawings above, FIGS. 5D and 5E have been amended in response to the Examiner's suggestion in the current Office Action. As a result, Applicant respectfully requests that the objection to the drawings be withdrawn.

III. The 35 U.S.C. §112 Rejections

Claim 7 was rejected under 35 U.S.C. §112 for allegedly being indefinite. The currently amended claim 6 recites "the set of counter nodal forces", which clarifies the indefiniteness raised by the Examiner. Therefore, Applicant submits claim 7 shall overcome the 112 rejection. Withdrawal of the 112 rejections is respectfully requested.

IV. The 35 U.S.C. §101 Rejections

Claims 1-15 were rejected under 35 U.S.C. §101 for allegedly being directed to non-statutory subject matter. Applicant respectfully disagrees.

At the onset, finite element analysis (FEA) may be used for simulating (i.e., analyzing) a structure to obtain structural responses under certain loading conditions. For example, FEA such as LS-DYNA® is used for simulating or analyzing an automobile in a highly non-linear event such as car crash or tire skidding. Even with the improvement of the computing power (i.e., a

supercomputer or massive parallel processors), the highly non-linear event (e.g., car crash) with a very detailed model (e.g., automobile with a million elements) still requires a long computation time to simulate in a FEA. For practical purpose, it is desirable to increase the computation efficiency such that a simulation can be performed within a reasonable turnaround time in one day or overnight. One of the methods for improving computation efficiency is to use under-integrated finite elements, which require less computing cycles. However, using under-integrated finite elements would create an undesired numerical phenomenon (not physical or real) referred to as "hourglass deformation". (see FIG. 1 of Specification). Therefore, in order to obtain real-world structural responses in a FEA using under-integrated finite elements, the "hourglass deformations" need to be controlled or compensated. One of the well-known techniques to compensate the "hourglass deformation" is to calculate a set of counter nodal forces that can be applied in directions opposite to the "hourglass deformation" such that the "hourglass deformation" is counter-balanced out or offset thereby controlled. For those of ordinary skilled in the art of the finite element analysis, calculating a set of counter nodal forces for controlling "hourglass deformations" is specifically defined and well understood.

The currently amended independent claims 1, 6 and 11 recite: "calculating a set of counter nodal forces for controlling the hourglass deformations in the local current element coordinate system from the generalized hourglass forces and the hourglass shape vectors, wherein the set of counter nodal forces is applied in directions opposing to the hourglass deformations such that the hourglass deformations are controlled in the finite element analysis for designing and analyzing structural product" (*emphasis supplied*).

The set of counter nodal forces is calculated for a special purpose – controlling or compensating the hourglass deformation of under-integrated finite element in a finite element analysis. Claims 1, 6 and 11 are not directed

to merely calculating a set of nodal forces, it is a specifically defined set of counter nodal forces configured for controlling the hourglass deformations so that the results of the finite element analysis can be used by a user (i.e., an engineer who designs and analyzes a structural product (e.g., an automobile or components of an automobile).

Because the present invention enables the control of the hourglass deformations of under-integrated finite elements in a finite element analysis for designing and analyzing a structural product such as an automobile or airplane, the finite element analysis results can be used for studying the physical behavior of the structural product when it is subjected to prescribed loads such as a surface forces, body forces and/or prescribed motions. If hourglass deformations were not controlled or compensated, the finite element analysis results would have contained bogus numerical "hourglass deformation" hence rendering the analysis results useless. Therefore, the claimed invention has a useful, tangible real world value (e.g., reduce automobile design time) and result (e.g., meaningful simulation for analyzing an automobile and its components).

Therefore, Applicant believes that independent claims 1, 6 and 11 shall overcome the 101 rejections, so do all of the dependent claims depend directly or indirectly to the independent claims. Reconsideration of claims 1-15 are respectfully requested.

V. The 35 U.S.C. §102(b) Rejections

Claims 1, 5, 6, 10, 11 and 15 were rejected under 35 U.S.C. §102(b), for allegedly being anticipated by Nagtegaal US Patent No.: 6,044,210, (hereinafter "Nagtegaal"). Applicant respectfully disagrees.

A. Independent Claim 1

Section 2131 of the M.P.E.P. explains that in order to anticipate a claim, "the reference must teach *each and every element* of the claim." This rule is set forth by statute and is routinely applied by the courts. Section 2131 even cites a case from the Federal Circuit Court of Appeals, which unequivocally states the rule: "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). As explained below, because Nategaal does not teach "each and every element as set forth" in Claim 1 of the present application, the §102(b) rejection of Claim 1, for allegedly being anticipated by Nategaal, cannot be properly maintained.

First, Nategaal does not teach a new limitation in presently amended claim 1: "calculating a set of hourglass deformation magnitudes as set forth in Equation as follows: ....(equation omitted)". The hourglass deformation magnitudes calculated by the Equation are quantities at corner nodes of the under-integrated solid element without any interior nodes. In contrast, Nategaal discloses an "hourglass strain" at the mid-body node. The "hourglass strain" is derived using the equation (1) of Nategaal, which requires two coefficients A_{tet} and B_{tet} that are specifically created for the first ten nodes (i.e., four corner nodes and six mid-edge nodes) of the second order tetrahedron. Those of ordinary skill in the art understand that equation (1) of Nategaal can only be used for the specific second order tetrahedral elements (i.e., the 15-node tetrahedron having four corner, six mid-edge, one mid-body and four constrained midface nodes). One cannot apply equation (1) to any other types of solid element. For example, an eight-node hexahedral element contains only eight corner nodes without any mid-body or mid-edge nodes. Blindly applying equation (1) to any four of

the eight corner nodes hexahedral element would result in a meaningless number manipulation. Therefore, for this first reason, Nategaal does not anticipate claim 1 of the present application.

Second, Nategaal does not disclose "establishing *a local current element coordinate system* of the solid element for a current deformed geometry of the solid element" (Emphasis supplied). In the OA, the rejection was reproduced as follows: "col. 7 lines 54-64 [of Nategaal], constrained coordinates where using coordinate of nodes to define element coordinates". The term "constrained coordinates" are referred to four midface nodes, which are constrained (i.e., no degree-of-freedom). Equations (3) and (4) of Nategaal are used for calculating current position of a point the first hexahedron of a tetrahedron. The "current position of a point" is not a local current element coordinate system for those of ordinary skill in the art of finite element analysis. It appears the "current position of a point" is referred to nodal coordinates of a point or node. Calculating current position of a point does NOT mean the calculation is performed in *the local current element coordinate system*. The calculation may well be carried out in an initial or original coordinate system local or global.
It also appears the Examiner may be confused with the terms "nodal coordinates" and "element coordinate system". The Examiner is referred to Applicant's July 10, 2007 response to the April 10, 2007 office action, in which the differences between "nodal coordinates" and "element coordinate system" is described and shown in detail extensively.
Additionally, there is no suggestion in Nategaal (or any of the other references cited in the current OA) that the method disclosed and claimed in Nategaal applies to anything other than nodal coordinate calculations as "calculating current position of a point". For at least this

second reason, Nategaal does not anticipate claim 1 of the present application.

Third, Nategaal does not teach "calculating a set of nodal coordinates of the solid element in *the local current coordinate system*" (Emphasis supplied). Rather, Nategaal only discloses how to calculate a current position of a point. There is no disclosure of coordinate systems at all. Moreover, Nategaal does not disclose, teach nor suggest two different coordinate systems (i.e., local initial element coordinate system and local current element coordinate system) as required in claim 1 of the present application. For at least this third reason, Nategaal does not anticipate claim 1 of the present application.

For at least the foregoing reasons, Applicant respectfully believes that the §102 rejection of claim 1 of the present application, as allegedly being anticipated by Nagtegaal, cannot be properly maintained. Applicant requests, therefore, that the rejection be withdrawn.

B. Independent Claims 6 and 11

Independent claims 6 and 11 incorporate similar features recited in currently amended claim 1 and were also rejected for the similar reasons as for claim 1. Applicants would like to apply the above remarks for claim 1 to support claims 6 and 11 also. Reconsideration of Claims 6 and 11 is respectfully requested.

C. Dependent Claims 5, 10 and 15

Claims 5, 10 and 15 depend from claims 1, 6 and 11, respectively. Therefore, they derive patentability by virtue of their dependence on what appears to be allowable base claims (Claims 1, 6 and 11). (*See* remarks/arguments above responding to the §102 rejection of claim 1.) Additionally, the rejection stated in the current office action is

reproduced as follows: "FIG. 4, tetrahedral element; when the tetrahedral element is in a thin plate or a shell, it is equivalent to a two-dimensional solid element with four nodes". Applicant respectfully submits that the Examiner's rejection is in error for the following reason.

A two-dimensional four-node solid element understood by those of ordinary skill in the art is a four-sided element, for example, axisymmetric or plane strain elements, which can be found in any textbook in the art of finite element analysis.

In the OA, the Examiner relies on FIG. 4 of Nategaal to anticipate a two-dimensional four-node solid element. It appears that FIG. 4 is a perspective view of a second-order 15-node tetrahedral element. When a tetrahedral element drawn on a piece of paper (e.g., FIG. 4 of Nategaal), the shape of the tetrahedral element may resemble a four-sided polygon or a three-sided polygon, but this does not make the tetrahedral element a two-dimensional four-sided four-node solid element in the art of finite element analysis.

As a result, claims 5, 10 and 15 are believed to be allowable over Nategaal and any other cited references. Therefore, Applicant requests the §102 rejection be withdrawn.

Should the Examiner maintain the §102 rejection to claims 5, 10 and 15 with the same reason, Applicant respectfully requests that the Examiner to show a reference in the art of finite element analysis that teaches, discloses or suggests "the tetrahedral element is in a thin plate or a shell, it is equivalent to a two-dimensional solid element with four nodes". If the Examiner relies on personal knowledge for the rejection, an affidavit must be submitted (see M.P.E.P 2144.03(C)).

Finally, Applicant submits that a tetrahedral element can never be a two-dimensional four-node solid element as claimed in claims 5, 10 and 15.

VI. The 35 U.S.C. §103(a) Rejections of Dependent Claims

Claims 2, 7 and 12 were rejected under 35 U.S.C. §103(a), for allegedly being unpatentable over Nagtegaal in view of Forssell et al. :"Creating a New Element Type", http://web.archive.org/web/20030214185408/http://impact.sourceforge.net/Manual_Programmers/Element.html, (hereinafter "Forssell").

Claims 3-4, 8-9 and 13-14 were rejected under 35 U.S.C. §103(a), for allegedly being unpatentable over Nagtegaal in view of Belytschko: "Element Technology", http://www.tam.northewstern.edu/tb/Book/Chapter%208.pdf, (hereinafter "Belytschko").

Claims 2-4, 7-9 and 12-14 are all depend from claims 1, 6 and 11, respectively, and they contain additional limitations further distinguish them from Nagtegaal, Forssell or Belytschko, viewed alone or in combination. Applicant respectfully traverses the rejection. Therefore, Claims 2-4, 7-9 and 12-14 shall be allowable for at least the reasons stated above with regard to independent claim 1.

VII. Final Notes Regarding Interview Request

A request (form PTOL-413A) was submitted via fax (1.571.273.3777) to the Examiner on Dec. 6, 2007. The undersigned (agent for the Applicant) received a phone call from the Examiner the next day stating the request was denied, even after the undersigned mentioned that Applicant is going to file a RCE (in fact, filing RCE is listed in the PTOL-413A).

One of the reasons Applicant believes that an interview would be beneficial to the progress of the present application is that there is an examiner change in the prosecution. The discussions made with the previous examiner need to be clarified again. For example, confusions about terms "nodal coordinate" and "element coordinate system" still exist in the current office action, although these terms were explained during the interview with the previous examiner, and were shown and described in the formal response to the previous office action.

CONCLUSION

In view of the forgoing, Applicant believes that all claims now pending in this application are in condition for allowance. Early and favorable action is being respectfully solicited.

If there are any issues remaining which the Examiner believes could be resolved through either a Supplementary Response or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned at (408)255-6853.

The fee associated with filing a RCE under 37 C.F.R. 1.114 has been paid via the Office electronic filing system. No additional fee is believed to be required for this amendment,, if it is determined that a fee is due in connection with this paper, the Commissioner is hereby authorized to charge payment of any fees associated with this communication or credit any overpayment, to Deposit Account No. 553308, including any filing fees under 37 CFR 1.16 for presentation of extra claims and any patent application processing fees under 37 CFR 1.17.

Respectfully submitted,

I hereby certify that this correspondence is being transmitted to the Commissioner for Patents via the Office electronic filing system on the date stated below.

Date: December 26, 2007

Signature: /Roger H. Chu, Reg. # 52745/
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